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V. *An Extract of a Letter to his Excellency Signior Francisco Cornaro, Ambassador from the Republick of Venice, to the Queen of Great Britain, &c. By Anthony Van Leeuwenhoek, F.R.S. Containing Microscopical Observations of the Salts of Pearls, Oyster-shells, &c.*

I Thought it my Duty to testify my Thankfulness by these few Lines, and therewith to join some of my poor Observations, &c.

*Pearls* are prescribed as a very wholesome Medicine upon divers occasions, to all those that are able to pay for them.

Now in order to make a Trial of the supposed Vertues of *Pearls*, I took seven little ones, all which being laid in a row together, did not exceed the length of an Inch. Then I put them upon a *Silver-Smiths* Charcoal Fire, and made them Red-hot; after which I threw them into clean Rain Water, which caused them immediately to burst in pieces; whereupon I took the *Pearls* and put them into a Glas Tube, and placed the Tube and *Pearls* over such a sharp Fire that they were both Red-hot. Upon the bursting of the *Pearls* there arose a Smoke, and there was also a yellowish Oyl drawn off from them.

Those Oily Particles stuck upon the sides of the Glas in divers places, and were divided into such exceeding small Globules, that several Thousands of them together did not amount to the bigness of a single Grain of Sand; but in other places the Particles of Oyl were coagulated into much larger Figures. When

When the Glass Tube where the Pearls lay began to melt, I threw those pieces of them that were burst with heat into clean Rain Water, and after they had been several Hours in the said Water, I poured it upon a clean Glass Plate, that it might evaporate ; and that being done, I discovered abundance of Salts that were coagulated in Rose-like Figures of several Magnitudes, and each of them different, insomuch that I could not prescribe any particular figure, only that I saw afterwards lying a great number of very slender and long Salt-Particles, some of which exceeded the others both in thinness and length ; upon another Glass there were a great number of Salt Particles coagulated in Figures like Branches and Boughs of Trees, which was a very agreeable Object, but there was nothing more remarkable therein.

I took about two thirds of the said Water and mingled it with one third of my Blood, which I drew out of my Thumb with the prick of a Needle ; and having so mingled it, I placed it before a Microscope, but could not discover that the Globules of Blood were coagulated in any other manner than when Blood is mingled with common Water.

The pieces of *Pearl* that came out of the Glass, and had been thrown into the Water, as is before mentioned, were not White, but Blackish ; whereupon I caused the Water, in which these Fragments lay, to evaporate, and they being dry, I put them upon such a strong Fire of Charcoal, that they turn'd White again ; whereupon I threw them again into clean Rain Water, and thereupon observed, that a great many Particles of them separated themselves from one another, and sunk to the bottom, in appearance, like white Chalk.

These Fragments of *Pearl* having lain a little time in Water, I observed a Scum to overspread the same, which in my foregoing Observations I had not seen ; and after a few Hours, that Scum grew thicker, and then I per-

seiv'd that it was nothing else but the coagulated Salt Particles, the figures of which at that time I could not discover; from whence I concluded, that the Salts, of which *Pearls* are partly composed, cannot be dissolved but by a violent Fire, or in strong Waters, and that *that* Heat that I had brought upon the *Pearls*, when they were in the Glass Tube, was not strong enough to separate the Salt Particles.

I took a drop of Water, which was very clear, from under that Scum that I told you before was composed of the Salts of *Pearls*, and I put the same upon a clean Glass, and observed in the space of two Minutes, that there was, as it were, a new Scum drawn over the said Water.

The next Day this Water was wholly evaporated, and where it had lain thickest, there was nothing to be seen but a white Matter, as it appeared to the naked Eye, but in reality, there was an incredible number of exceeding small Salt Particles, which for the most part were so strongly coagulated, that there could be no particular Figure discovered in them, but where the Water had lain thinner, there the Salt Particles were coagulated in the form of Boughs and Branches of Trees.

Now, forasmuch as the Water, in which those burnt *Pearls* lay, was mostly evaporated, I put some fresh Water upon them to try whether the Salts would not coagulate in larger Figures.

After this Water had been about a Minutes time poured upon the *Pearl* Particles, and that I judged them to be sunk to the bottom, the Superficies of the same Water was again covered with another Scum.

I then took a little of that Water also, as clear as I could, from under the Superficies of it, and put a little thereof upon two very clean Glasses, and presently discover'd a new Scum spreading over the same, which according

cording to all appearance, was nothing else but the coagulated Salts.

After that the burnt Fragments of *Pearl* had been infused in this Water two or three Days, I discovered a few large Salt Particles, like the first mentioned Salts, and of divers Figures, some of them were as clear as Chrystal; and I could likewise perceive in some of the small Salts, that lay at distance from the rest, their particular Figures, and they also were as clear as Chrystal, but where they lay thicker together, they appeared to the naked Eye to be nothing but a white Matter.

After these burnt *Pearls* had laid about five Days in the Water, their Salts had such an influence upon *Copper*, as to turn it Green in several Places.

In order to be further satisfied, I took some of the abovementioned *Pearls*, and folded them in a thick Post Paper 4 times double, and beat 'em upon an Anvil to Powder; then I put the Powder into a little clean *Copper* Porringer of a Hemispherical Figure, and poured clean Rain Water upon the same, then set it over the Fire and boiled it till two thirds of the Water were evaporated.

I took some of the Water, and put it upon clean Glass Plates, in order to see how far the *Pearl* Powder had impregnated the same with its Salt Particles.

After that this Water had stood some Hours, it seem'd to me as if there was something floating upon it, but when I view'd it with a Microscope, I could not judge it to be any of the Salt Particles, but rather small whole *Pearls*.

The Water that I had placed upon clean Glasses having been exhaled, I view'd the remaining Particles with my Microscope, and saw several exceeding small Salts, of the same Figure with the former.

For further satisfaction, I caused the said Copper Por-ringer to be well cleaned, and poured in as much Raia Water, as had lain upon the broken Pearls, and then set it over the Fire again, and boiled it till two thirds were wasted ; then I put the same Water upon clean Glasses in order to evaporate, to the end that I might see whether there were as many Salt Particles in this Water, as there were in that, wherein I had infused the Powder Pearls, but the difference was so little that it was not worth naming.

But as the Salt Particles of both the last mentioned Waters were so soft, that when they were coagulated in dry Weather, my Breath alone was sufficient to reduce 'em to a Watry Vapour ; on the contrary, the Salts that were coagulated from the burnt Pearls, were so inflexible, that I imagined, they could not be dissolved any other way, than by Fire, or very sharp Waters.

Now since we see, that notwithstanding the boiling of Pearl Powder in Water, so few Salts are extracted from it, that its hardly worth the speaking of ; we have a great deal of reason to believe, that the Stomach and Bowels have a much less power over the Pearl Particles that are given to Sick Men ; and as for what belongs to the Salt Particles, wherewith the Water is impregnated by burning of the *Pearls*, and which coagulate in the Water, like a petrified Matter, we ought to believe, that those do rather prejudice than profit our Bodies ; and the more, because the Juices, that remain in the Stomach and Bowels, do so coagulate the Salts of those Meats and Drinks which we make use of, that few or none of them mingle themselves with the Blood, but are discharged with the rest of the Excrements ; and those Salt Particles, which do not coagulate, we ought for the most part, to look upon as bad as Poison, and especially those which put our Bowels into such a motion, as to protrude the Chyle too hastily : This is plainly seen in the

the Sea-fishes, which tho they swim in Salt Water, and always receive the same into their Stomach and Bowels ; yet none of the Salts mix with their Blood, but coagulate in such a manner in the Stomach and Guts, that they assume the figure of Diamonds, and pass through their Bodies, together with the Excrements.

In short, we may conclude, that *Pearls* are useless, and that there is no manner of advantage to be had from them in the way of Medicines, and consequently that they are good for nothing else but to empty Rich Mens Pockets of their Money ; and I must needs own that I have the same opinion of Gold too, tho I have often heard that mightily cry'd up by some People, and so again is Silver by others.

But those that have dissolved Gold and Silver, and know how they coagulate again, and consider moreover, that Gold is 18, and Silver 10 times heavier than our Blood ; they know, that altho Gold and Silver could enter into the Blood, (which yet is unconceivable,) it can never be assimilated or mingled therewith ; now if this be true, 'tis plain that the aforesaid Mettals do only serve to enrich those that prescribe them.

To return again to the business of the *Pearls* ; I view'd them again with my Microscope, and observed that the scaley Particles, of which the *Pearls* were composed, were much thinner than they had appeared before.

I imagined also, that in some of the *Pearls*, I could see the very place, where they had been joined to the Shell, and at which they received their Nourishment and encrease, vvhich I suppose to happen after the same manner, as the Gall-Nuts are produced upon the Leaves of *Oaks* ; that is to say from a superfluity of Matter, or else from Wounds or Obstructions in the Vessels.

Now, since *Pearls* are produced as it vvere accidentally (and after the manner abovementioned) in the Shells of

of *Oysters*, there is no doubt but that they have one and the same Salt Particles, and consequently that their Operations are uniform.

For my farther satisfaction, and for want of those *Oyster-Shells*, in which *Pearls* are found, I took two Shells that had been for four Years together nailed upon the Bulk, of a Man that sells *Oysters*; upon a supposition, that I should find no kind of Salt Particles in such Shells, and moreover, that they were as dry as the *Pearls* themselves.

The biggest of those *Oyster-Shells* I judged to be six Years Old, and that the thickest part of it was something more than one sixth of an Inch.

I split this *Oyster-Shell*, and observed several *Scaley* Particles of it to be of a shining whiteness, something like what we call *Mother of Pearl*; and when I view'd these Particles with my Microscopæ, I observed that the little Scales, of which the *Oyster-Shell* is composed, to be as thin as those that *Pearls* consist of.

Yea, I judged that the *Scaley* Particles of the *Oyster-Shells* lay as many times upon one another, as the *Oyster* was days old: In another place instead of *Scaley* Particles, there was nothing but (as it appeared to the naked Eye) a white Chalkey Matter.

These *Scaley* Particles are composed of exceeding small Vessels, by which they certainly receive their encrease from the Fish, and which extend themselves so many several ways, that it was impossible for me to follow them with my Eye: Now, as I said before, it is possible that from an over-flowing of Nourishment, &c. there may be such a matter protruded, as shall afterwards be coagulated and turn it self into a hard Globular Figure.

Moreover, I took some of the inmost split Particles of the *Oyster-Shell*, which were very clean and white, and put them upon a Fire of Charcoal, and having made them

them glowing hot, I threw them into clean Rain Water, whereupon the Particles of the Shell were separated from one another, and appeared like Meal or Ghalk ; and presently after, I observed a Scum overspreading the Superficies of the Water, which increased and grew thicker from time to time, and which plainly appeared to be nothing else than the coagulated salt Particles ; and when this Water had stood three Days, there was such large salt Particles coagulated, and composed of so many several Figures, and so clear, that 'twas a Pleasure to behold them ; and tho after that time, by stirring and breaking that Scum, I had caused it to subside to the bottom of the Water, and had poured more fresh Water upon the said Particles of the *Oyster-Shell*, there succeeded quickly after a new Scum, but it was not near so thick as the first.

Now if the common *Oyster-Shell* has such an Analogy with the Particles of *Pearls*, we cannot doubt but that Shell which produces *Pearls* has yet a much greater likeness, so that we may well conclude, that *Pearls* are of no real use in Physick ; and who knows, that most of those Physicians who put such a value upon *Pearls*, *Gold* or *Silver*, with respect to their use in Medicines, did ever set themselves, to make a nice enquiry into the Powers of them, but only contented themselves with a servile imitation of others.

Furthermore, I took some of the inmost parts of the said *Oyster-Shell*, and proceeded with them after the same manner as I had done before, with the broken *Pearls* ; that is to say, I boiled them in Rain Water, and observed likewise that the said Water had no Scum upon it.

I caused this Water to evaporate, and then observed more salt Particles in that than in the Water above mentioned ; and these Salts were so soft, that my warm Breath alone was sufficient to turn them into a Vapour.

The Heer Peter Valkenier had presented me formerly with a large piece of an *Oyster-Shell*, which was found upon the high Mountains of *Switzerland*, where it had lain, in the Opinion of some Persons, ever since the Flood ; this Shell was not White, but rather of a dark Grey ; it had been scaled or worn away very thin, and in the Cavity where the Fish lay, there was a little piece of another *Oyster-Shell*, as it were cemented to it, and when I separated it with some violence, there lay a yellowish Clay in several little Holes or Pits in the *Oyster-Shell*.

I broke off a little piece of the said Shell, and making it red hot, threw it into clean Rain Water, and then observed that most of the Particles, that were separated from one another, were like a white Chalk ; and I could perceive in the space of a Minute, that upon the Superfices of the Water there was an exceeding thin Scum, which from time to time grew thicker, and which I separated several times from the Water ; but it appeared to me to be nothing else than coagulated salt Particles, which after two or three Days time were not only grown much larger, but in some few of them I discovered as exact figures, as I mentioned before in the first *Oyster-Shell*.

Now, since an *Oyster-Shell*, had lain so many Years in the Earth, and remained there without being disposed to Corruption, 'tis plain that the preservation thereof was owing to those fix'd salt Particles, of which it was partly composed, and which could be no otherways divided than by Fire.

*Delft, December 18, 1705.*